Space Weather Technical Forecast

Issued on Thursday, 08 February 2024 at 01:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Moderate activity expected with isolated M-class flares/R1-R2 Radio Blackouts. Chance of isolated X-class flares/ R3 Radio Blackouts, mainly Day 1 (8th Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with isolated M-flares, the peak flare a M5.1 at 07/0331UTC from AR3575. There are currently nine sunspot regions on the visible disc, however the majority of these are small and relatively stable with only two regions of significance; AR3576 remains a large and magnetically very complex region in the southeast, with a classification of Fkc/beta-gamma-delta. Magnetic looping is evident in SDO imagery between this region, and several other regions on the southeast disc in close proximity to A3576. However, despite AR3576's size and complexity it was AR3575, a smaller but still complex region, which has been responsible for the M-flares over the past 24 hours. The viewing angle and position of this region, as it approaches the southwest limb, is making analysis tricky and therefore the previous classification of Dkc/beta-gamma-delta is maintained.
A CME that left the disc from near AR3575 early on the 7th has been analysed and Enlil modelling indicates that this CME is not expected to be Earth directed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1 were generally indicative of a weak fast wind from a coronal hole, with speeds generally around 500 km/s, peaking at 549 km/s at 07/2114 UTC. Density was predominantly been below average. The Interplanetary Magnetic field (IMF), Bt, was weak at 6nT or below. The north-south component Bz, has weakly fluctuated between +4nT and -5nT. Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux remained at background levels. GOES16 high energy (greater than 2MeV) electron flux was largely at background levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold, measuring 1.18e6 integrated flux at 08/0000 UTC, with a flat trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity expected, with isolated M-flares and a chance of X-flares. These most likely from two large and complex regions, either AR3576 in the southeast, or from AR3575 in the southwest. The risk reduces slightly as AR3575 rotates off behind the southwest limb today (08 Feb).

Solar Wind / Geomagnetic Activity: The residual enhancement to solar winds from CH96/+ is expected to gradually wane through today (8th Feb), but especially tomorrow (9th) with wind speeds eventually declining to slow-ambient levels. A CME that left the Sun in association with the M4.2 flare in the morning of 6th Feb may provide a slight glancing blow late tomorrow (9th Feb) or through Day 3 (10 Feb).

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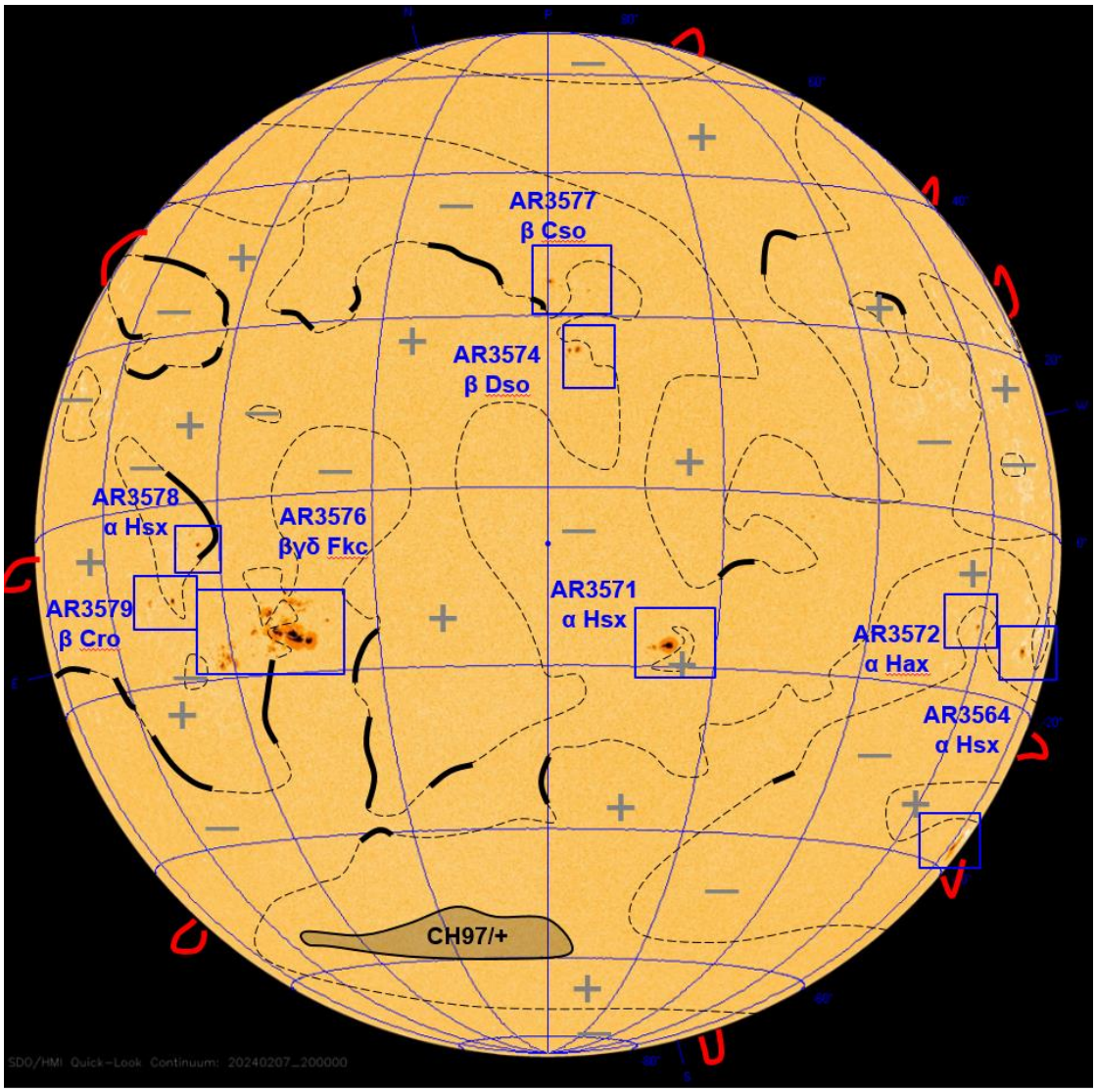
The CME associated with the M5.1 flare earlier on the 7th may give some slight enhancement at Earth later in the period, but this is both low confidence and a low probability. Geomagnetic activity is expected to be mostly Quiet (Kp 0-2), with a chance of Unsettled intervals (Kp 3) and a very slight chance of a G1/Minor Geomagnetic Storm interval (Kp 5), should any CME enhancement occur Days 2-3.

Energetic Particles / Solar Radiation: High energy proton flux has the potential to rise in response to any significant flares, most likely from AR3575 or AR3576. AR2576 will move into a more central location through the period, becoming the main risk region. Significant flares from these regions result in an initial chance of exceeding the S1/Minor Radiation Storm level, this declining to a slight chance from tomorrow as AR3575 rotates further behind the southwest limb. High energy electron flux (greater than 2MeV) is expected continue at generally low to moderate levels, likely becoming mostly moderate by the end of the period. However, the fluence will remain well below the Active threshold, despite a probable very gradually upward trend.

Figure 1. Solar Analysis Valid 07/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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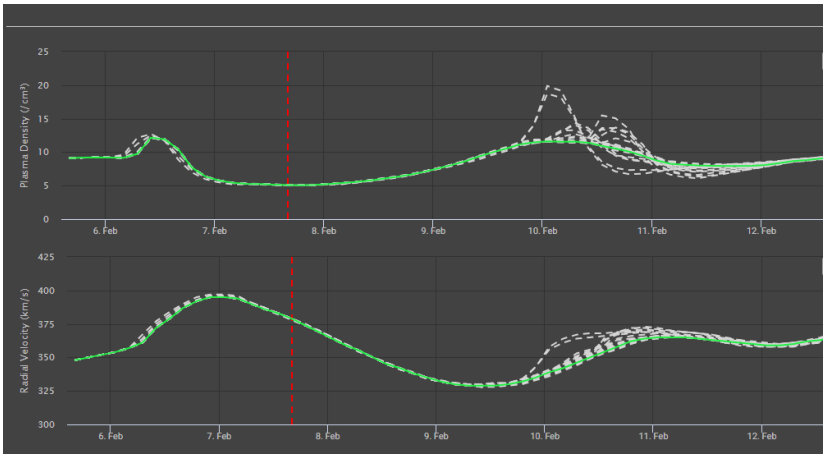
Geomagnetic Storms:

Solar winds are currently slightly enhancement due to the previous small coronal hole, CH96/+, which is now no longer visible. A gradual decline in the HSS is possible today, (8th Feb), but more likely tomorrow (9th), with wind speeds eventually declining to slow-ambient levels. Enlil indicates that a new weak HSS may arrive through day 3 (10th), likely from CH97 in the southern hemisphere. If this CH features does connect with Earth it is expected to be later than shown by Enlil, with only weak geomagnetic impacts.
The CME that left the Sun in association with the M4.2 flare early on 06 Feb may give a glancing blow late tomorrow (9th February) or through Day 3 (10th), bringing a very slight chance of a G1/Minor Geomagnetic Storm interval, in conjunction with any weak HSS influence. However, a miss is more probable. The CME associated with the M5.1 flare at 07/0330 UTC has been analysed and is expected to miss Earth.
Geomagnetic activity is expected to be mostly Quiet (Kp 0-2), with a chance of Unsettled intervals (Kp 3) and a very slight chance of a G1/Minor Geomagnetic Storm interval (Kp 5), should any CME enhancement occur Days 2-3.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Met Office Enlil ensemble forecast showing a few members with a weak CME arrival either late tomorrow or through day 3.



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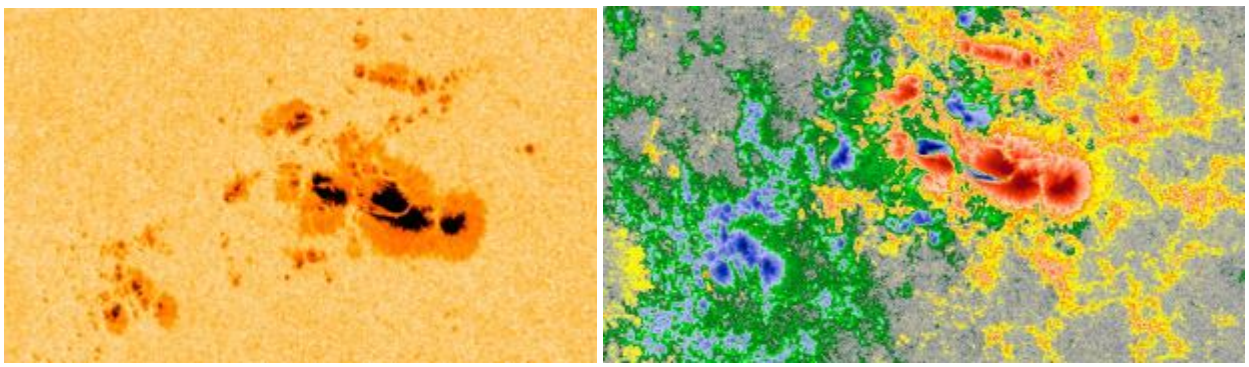
Radio Blackouts - X-Ray Flares:

There are nine sunspot regions on the disc, two of which are significant and complex, as previous regions AR3565 and AR3573 have faded to plage. AR3576 in the southeast is a large region with several delta spots, including one complex and sheared delta spot in the leading spot. Also evident on SDO-AIA imagery is broad and wide-reaching magnetic looping. This region continues to evolve, with the recent proliferation and fading of numerous small spots. AR3575 in the southwest is now tricky to analyse, due to its position close to the southwest limb. As such its classification has been maintained. Whilst smaller than AR3576, this region therefore has complex magnetic structure.

AR3564 appears to have decreased to become Hsx/alpha, although this could be as a result of the viewing angle as the region approaches the west limb. AR3574 has been reclassified as Dso, due to rudimentary penumbra recently developing on its small trailing spot. AR3577 in the north centre disc remains reclassified as Cso/Beta. The other regions on the disc are generally much smaller and magnetically simpler.
Moderate activity expected, with isolated M-flares and a chance of X-flares. These most likely from two large and complex regions, either AR3576 in the southeast, or from AR3575 in the southwest. The risk reduces slightly as AR3575 rotates off behind the southwest limb today (08 Feb). However, new or returning regions are expected to rotate onto the visible disc through the period, with the chance of significant flares increasing again.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	50	50	50
Very Active	R3 to R5 X Class	No	20	10	10	10

Figure 3: SDO/AIA imagery intensitygram (left and magnetogram (right) of AR3576.



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Solar Radiation Storms - (High Energy Protons

GOES18 high energy (greater than 10MeV) proton flux is currently at background levels. The high energy proton flux has the potential to rise in response to any significant flares, most likely from AR3575 or AR3576. AR2576 will move into a more central location through the period, becoming the main risk region. Significant flares from these regions result in an initial chance of exceeding the S1/Minor Radiation Storm level. This declining to a slight chance from tomorrow as AR3575 rotates further behind the southwest limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Solar winds are currently slightly enhancement due to the previous small coronal hole, CH96/+, which is now no longer visible. A gradual decline in the HSS is possible today, (8th Feb), but more likely tomorrow (9th), with wind speeds eventually declining to slow-ambient levels. Enlil indicates that a new weak HSS may arrive through day 3 (10th), likely from CH97 in the southern hemisphere. If this CH features does connect with Earth it is expected to be later than shown by Enlil, with only weak impacts on the high energy electron flux.
High energy electron flux (greater than 2MeV) as observed by GOES-16 is expected continue at generally low to moderate levels, likely becoming mostly moderate by the end of the period. However, the fluence will remain well below the Active threshold, despite a probable very gradually upwards trend.
The associated 24 hour electron fluence is expected to remain well below the Active (1e8 integrated flux) threshold, as suggested by MOSWOC's REFM, which is currently thought to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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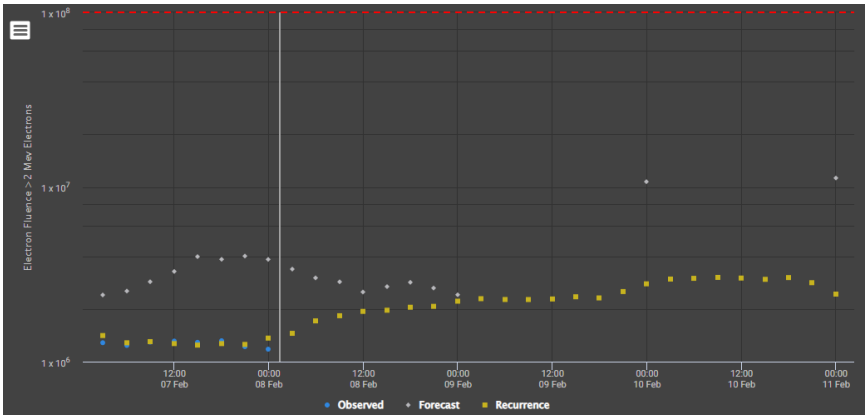
Figure 5: MOSWOC REFM.



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